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SOURCE Stanki 1 Instrument, No 1, 2, 1953.

COMPARISON OF USSR PREWAR AND POSTWAR MACHINE TOOLS

[Numbers in parentheses refer to appended sources.]

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All types of machining operations have been embracing high-speed methods. However, the results obtained in different fields and on different machine tools have not been the same. In operating a single-tool machine, for example, certain Stakhanovites have achieved cutting speeds up to thousands of meters per minute; yet, in machining steel on a multispindle automatic bar-type lathe, a speed of 40-60 meters per minute is considered high although a speed of 80 meters per minute has been reached in some operations.

The application of high-speed methods on prewar multispindle lathes has been limited by a number of factors. These can be broken down into three categories: the machine tool, cutting tool, and the blank or bar stock. A further breakdown of these categories reveals many shortcomings. These include low speed, power, rigidity, and vibration resistance of the machine tool; poor tool design and selection; unsatisfactory chip breakage and removal; unsatisfactory methods of clamping the bar or blank; and many other underlying reasons which hamper high-speed operation.

At present, the type range (tipach) of horizontal multispindle automatic and semiautomatic lathes is being completely modernized in the Soviet Union. Many of the approved machines have already been put into series production while experimental models of other machines have been tested.

Although the new machine tools are being produced at different plants and each model has its own special features, the general trend of their development can be pointed out.

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For example, Model 1A266 six-spindle automatic bar-type lathe (V. I. Dikushin, chief designer) manufactured by the Stankokonstruktsiya Plant of the ENIMS is of absolutely original Soviet design and has been built on the principle of hydro-electric control. The auxiliary operations, the length of which do not depend on the total cycle time, are accomplished by means of a control shaft. One revolution of this shaft performs the following operations: feeds and clamps the bar, withdraws the locking pins from the spindle carrier (shpindel'nyy blok), indexes the carrier 60 degrees, and locks it in position. All slides are moved hydraulically. A system with throttle control and a centralized pumping station has been used in the machine tool. The spindle carrier is lifted for indexing and locked in position for machining by hydraulic means. The control shaft is disengaged by means of a friction clutch activated hydraulically.

The chief advantage of the hydraulic automatic is the camless arrangement which makes possible the kinematic setup of specified feeds and amount of slide travel in the short period of 30-40 minutes. Each slide has independent feed which is selected by the turn of a dial.

The maximum spindle speeds of new machines tools have been increased by 30-50 percent as compared with prewar models. In the following graph, the upper curve shows the maximum spindle speeds of new models and the lower graph, those of prewar models:

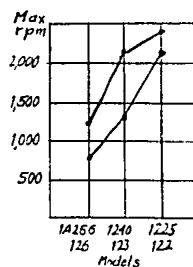


Figure 1

The drive power has also been increased but the dimensions of basic parts have not been changed. In the following graph, the upper curve shows the power of new models, and the lower curve, that of prewar models:

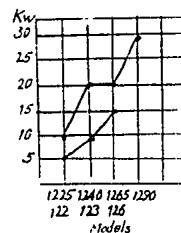


Figure 2

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Spindle rigidity and accuracy of motion have been increased. In all models except Model 1225, two-row cylindrical roller bearings with a tapered hole have been used for the front bearings. These bearings have given good results at high speeds. The rigidity of the spindle has been increased by a somewhat larger neck diameter and smaller overhang. The bar stock is clamped by means of a roller clutch. Clutches with levers are used only in large machine tools.

Chip removal has been mechanized, the safety of the worker has been given special consideration, and many other improvements have been made in the design of the new machine tools.

In connection with the factors which limit accelerated machining conditions on multispindle lathes, it is interesting to note the results of the tests performed on the new experimental models at high speeds. D. F. Lobanov, A. Ya. Lopata, N. P. Suvorov, and workers at the Moscow Machine Tool Building Plant imeni Ordzhonikidze participated in the testing.

The new models of horizontal multispindle lathes have been perfected since the end of World War II.(1)

The results of testing postwar multispindle lathes and comparing them with prewar models are summarized as follows.

Inspection of shafts machined on Models 1266 and 1290 showed completely satisfactory results. (Model 1290 is produced by the Kiev Machine Tool Building Plant imeni Gor'kiy.)

The following table shows the results obtained in testing Models 1240-6 and 1240-6P for static rigidity with a 500-kilogram load:

<u>Model</u>	<u>Unit</u>	<u>Rigidity, kg/mm</u>
1240-6	Spindle	10,000-12,500
	Spindle carrier (block)	50,000
	Cross slide	10,000
	Longitudinal slide	10,000
1240-6P	Spindle	20,000
	Spindle carrier	100,000
	Cross slide	3,600-4,200
	Longitudinal slide	5,000

Models 1240-6, 1240-6P, and 1290 were tested for force balance (silovoy balans) and the coefficient of efficiency of machine-tool drive. Because the coefficient of efficiency of multispindle machines cannot, for technical reasons, be determined by braking, an approximation method had to be employed. For this reason, the coefficient of efficiency of machine-tool drive is weighted by 7-10 percent.

When the machines operate under intensive cutting conditions and at high spindle speeds in machining complex parts, it can be considered that the coefficient of efficiency of machine-tool drive, even on the experimental unperfected models lies in the range of 0.7-0.8 and without a doubt can be somewhat higher for series-produced machine tools. With further modernization of these machine tools, it can be expected that the coefficient of efficiency of the semiautomatic-machine drive will be approximately 0.1 higher than that of automatics.

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The effectiveness of design of the new models as compared with prewar models has increased considerably. The formula, $a = \frac{G}{N}$, where G equals the weight of the machine tool in kilograms and N equals the rated power in kilowatts, was used to determine the effectiveness of design. The average value of "a" for Models 122, 123, and 126 is 580-700 kilograms per kilowatt. In the new models of multispindle automatics, the effectiveness of design has been increased, since "a" equals only 450-500 kilograms per kilowatt.

If the power used for expediency in high-speed cutting is taken for the value N, then the value of "a" would be even smaller, or 300-350 kilograms per kilowatt.

In spite of these figures which characterize satisfactory effectiveness of design, the designers and technologists are faced with the serious problem of decreasing the weight with concurrent improvement of technical and operating characteristics of multispindle lathes now being perfected.

The following table illustrates the absolute productivity of new models at conventional and high-speed settings:

<u>Model</u>	<u>Number of Working Spindles</u>	<u>Power of Electric Motors</u>	<u>Workpiece Material; Cutting Speed; Feed; Depth of Cut</u>	<u>Spindle Speed</u>	<u>Absolute Productivity</u>	<u>Coefficient of Power Utilization</u>
1240-6	6	20+2.3 kw	Steel 35; max speed 33 m/min; longit feed, 0.235 mm/rev; cross feed, 0.038 mm/rev	715 rpm	6.4 kw	0.3
1240-6	6	20+2.3 kw	Steel 35; max speed, 112 m/min; longit feed, 0.42 mm/rev; cross feed, 0.58 mm/rev	1,010 rpm	11.4 kw	0.51
1225-6	6	12 kw	Steel 35; max speed, 113 m/min; longit feed, 0.42 mm/rev; cross feed, 0.05 mm/rev	1,640 rpm	12.4 kw	1.03
1240-6	6	20+2.3 kw	Steel 35; max speed, 155 m/min; longit feed, 0.6 mm/rev; cross feed, 0.08 mm/rev	1,440 rpm	20.8 kw	0.93
1240-6P	5	20+2.3 kw	Steel 45; max speed, 147.5 m/min; longit feed, 0.33 mm/rev; cross feed, 0.195 mm/rev	603 rpm	30.4 kw	1.36
1290-4	4	23+0.6 kw	Steel 45KhN; max speed, 165 m/min; longit feed, 0.2 mm/rev; depth of cut, 3 mm	523 rpm	34.0 kw	1.19

This table shows that modern domestic designs of automatic and semiautomatic multispindle lathes are now making it possible to utilize fully the rated power.

The degree of automatization of multispindle automatics and semiautomatics produced after the war has also sharply increased. If conditional coefficients are used to estimate the degree of automatization, new models can be considered 30-40 percent more automatized than prewar models as shown in the following tables:

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Table A

<u>Model</u>	<u>Conditional Coefficient of Automatization</u>
123	0.70
1261	0.78
1225-6	0.88
1240-6	0.91
1A166	0.91

Table B

<u>Model</u>	<u>Conditional Coefficient of Automatization</u>
123P	0.49
127	0.51
1225-5P	0.65
1240-6P	0.69

The cost of manufacturing parts on new models of multispindle machine tools at intensive operating conditions cannot be accurately calculated because the labor consumption in manufacturing them on a series-produced scale has not been determined. For this reason, only approximate comparative data can be adduced. An analysis of the relative cost of production is available in source document 7.

In testing machine tools at the Plant imeni Ordzhonikidze, noise was measured with a noise gauge in decibels, and with a phonometer in phons. The noise in a shop at the plant measured 72-73 decibels, or 75 phons.

At present, the new model multispindle automatics and semiautomatics have not been in operation long enough to provide sufficient data for listing improvements which should be incorporated in the design of these machine tools in further modernization. However, it can be said that a rather large number of Model 1225-6 automatics produced by the Plant imeni Ordzhonikidze and operating continuously at tractor plants in two- and three-shift continuous operation have been completely reliable.(2)

SOURCES

1. Moscow, Stanki i Instrument, No 1, Jan 53
2. Ibid., No 2, Feb 53

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